



Case report

Primarily unrecognized thoracoabdominal impalement in a motorcyclist

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ABSTRACT

In traffic accidents, fatal impalements are mostly seen in vehicle occupants injured by penetrating blunt-tipped objects such as fence posts or iron bars. Compared with this group of road users, the medical literature lacks reports on impaled motorcyclists. The article presents a case which deserves attention in several respects:

1. Both the impaling object and the victim were moving at the moment of penetration.
2. The lethal impalement trauma remained unrecognized until autopsy, particularly since the causative object did not get stuck in the wound track.
3. Two different body parts (head and trunk) were consecutively affected analogous to re-entry wounds in gunshots and stabs.
4. Due to the tubular shape and the sharp-edged end of the penetrating instrument (stanchion of a broken front-wheel's fork), clothing and soft tissues were punched out along the wound channel and partly remained lodged in the tube's cavity.

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1. Introduction

Impalement injury is a special kind of penetrating trauma caused by mostly rod-like objects which enter the victim along the longitudinal axis resulting in a canal-shaped wound track of corresponding length [1]. Diagnostic problems may arise when the instrument did not get lodged in the body or when the impaling object does not protrude from the entrance wound. A rather inconspicuous skin wound may also contribute to the underestimation of the real penetration depth, for instance in intracranial impalements [1,2]. Therefore, it is not surprising that the impaling mechanism is sometimes determined only at autopsy [1,3–8].

In clinical medicine, attention is primarily focused on diagnostic and therapeutic issues (e.g. the application of CT or MRI and the methods of the surgical procedure). Consequently, impalement injuries are subdivided mainly according to their location (intracranial, facial, cervical, thoracic, abdominal, the genital/perineal/anal region or the limbs). From the forensic point of view not only reconstructive aspects but also the manner of infliction is of great significance. In this respect, the medicolegal expert often has to rely on information from the police and other specialists engaged in the relevant case.

The majority of impaling trauma is accidental, occurring in road traffic collisions [5,6,9–25], at work (building/construction sites) [4,8,26–32], in sports or during children's play [2,33–35]. In contrast, only a comparatively small number of abusive, homicidal or suicidal impalements are reported in the pertinent literature [36–39]. In genital or anal impalements, a sexually motivated infliction must be considered [40–46].

The case described in the following deals with a thoracoabdominal impalement injury sustained by a motorcyclist in a collision with an oncoming car. To the best of our knowledge, the special constellation of this fatality is unique so that a short presentation of its special facts and findings seems to be justified.

2. Case report

2.1. Case history

The traffic accident, which involved two motorcycles and a passenger car, happened on a country road. At the end of a right-hand bend and the beginning of a blind left-hand bend, a car driving up a hill started to overtake another vehicle. When the car had drawn level with the vehicle to be overtaken, it collided head-on with two oncoming motorcycles driving directly one behind the other. The front wheel of the motorcycle first hitting the car (in an upright driving position) was ripped off the vehicle together with the stanchion tubes of the fork (Fig. 1). In spite of maximum braking, the second motorcycle collided with the car while sliding on its side. The driver was flung off the motorcycle and came to a

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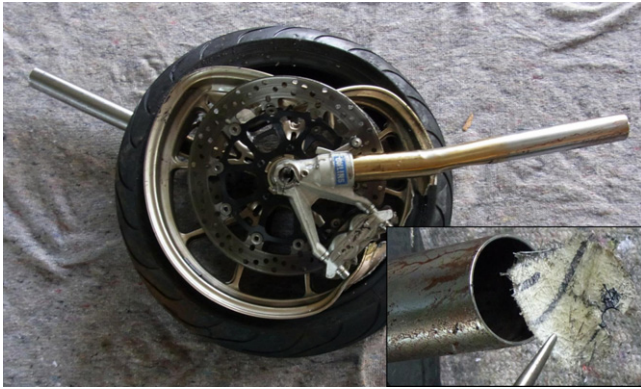


Fig. 1. Separated front-wheel with the stanchion which had acted as impaling object (a). The close-up view (b) shows the blood-stained tube containing synthetic material from the helmet.

stop on the right shoulder of the road after about 70 m with his helmet strongly damaged (Fig. 2a). Both motorcyclists died at the scene of the accident. In both cases, death was assumed to have been caused by blunt craniocerebral trauma.

2.2. Autopsy findings

Forensic autopsy of the motorcyclists was ordered to clarify the cause of death and reconstruct the accident. At the time of the autopsy, only the protective clothing of the motorcyclist first colliding with the passenger car was available. According to the results of the examination he had died from the consequences of blunt thoracic trauma.

The second motorcyclist showed an about 10 cm large, gaping skin perforation with abraded wound margins in the right upper dorsal region (Fig. 3). The wound track steeply descended into the right thoracic cavity. In the right occipital region, a minor lesion of the hairy scalp was found (Fig. 2b).

In the abdominal cavity, white material resembling styrofoam was detected caudal to the liver (Fig. 4). After lifting the liver, a small piece of hairy scalp became visible. On the right posterior thoracic wall, comminuted fractures of the ribs 5–8 were discernible with parts of the fragments being displaced inward

(Fig. 5a). The lower lobe of the right lung showed a channel-like longitudinal perforation (Fig. 5b). The wound track contained numerous foreign bodies (whitish styrofoam and greyish-black plastic particles). The diaphragm was ruptured and the right lobe of the liver was crushed (Fig. 6). Apart from the foam particles and rib fragments, greyish-black synthetic material from the protective clothing of the accident victim was also found in the abdominal cavity (cf. Fig. 4).

The wound track extending from the right upper dorsal region to the undersurface of the right hepatic lobe was about 30 cm long. It was an impalement injury caused by an object perforating the right lower pulmonary lobe, the diaphragm and the right hepatic lobe. Apart from the minor scalp lesion, no other injuries, in particular no craniocerebral trauma, could be demonstrated.

2.3. Complementary investigations

As the injuring mechanism was unclear at first, the site of the accident, the motorcycles involved and the protective clothing of the motorcyclist sustaining the fatal impalement injury were inspected. It was found that the front wheel of the motorcycle first colliding with the car had been ripped off and the fork had broken.

One of the two stanchion tubes showed traces of blood (cf. Fig. 1b). The DNA profile of the 16 analyzed STR markers was consistent with that of the motorcyclist with the fatal impalement injury.

The metal stanchion tube, which was sharp-edged at the end, had a diameter of approximately 4.5 cm and a total length of 42 cm. It contained a piece of synthetic material from the helmet of the impaled motorcyclist (cf. Fig. 1b).

At the back, the helmet showed a round defect with a diameter corresponding to the diameter of the cylindrical stanchion tube. From this primary contact site, a gaping tear of the outer shell of the helmet and its filling material ran to the right nape (cf. Fig. 2a). The textile material of the motorcyclist's outer clothing was perforated in the upper dorsal region corresponding to the gaping skin wound of the victim.

2.4. Accident reconstruction

According to the expert opinion on the technical aspects of the accident, the deformation of the motorcycle and the damage on the

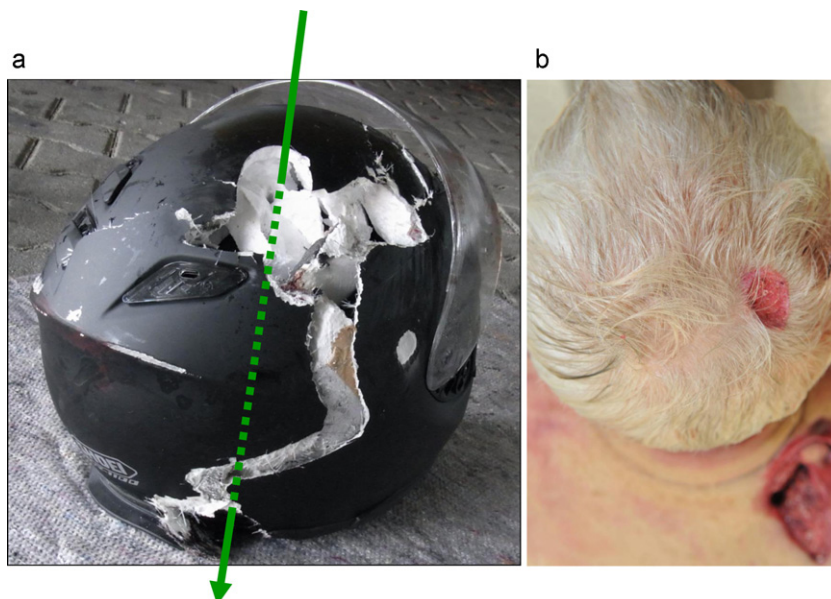


Fig. 2. Damaged helmet of the motorcyclist (a) and corresponding skin lesion of the scalp (b).

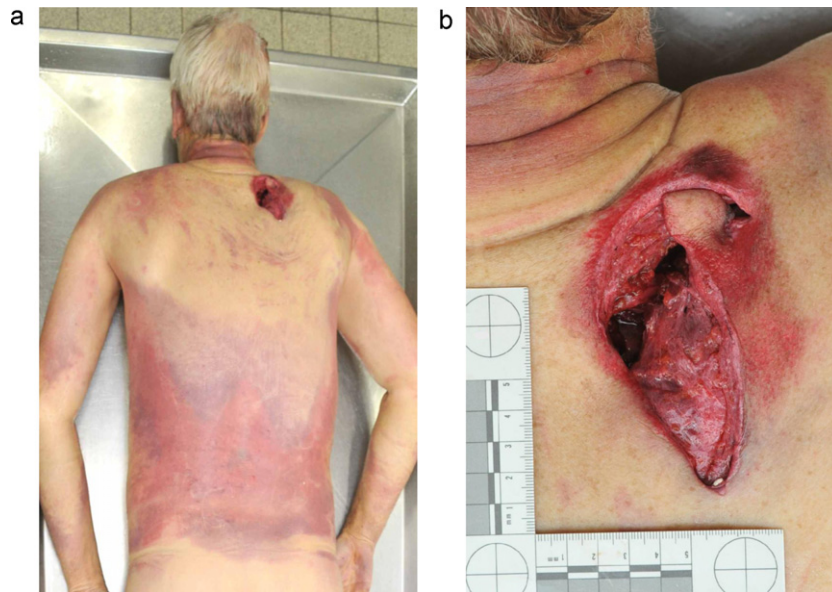


Fig. 3. Dorsal aspect of the trunk with large skin perforation (a) and close-up view of the entrance wound (b).



Fig. 4. Displaced foreign material recovered from the abdominal cavity (cut-off piece of the scalp [arrow], parts from the protective clothing, rib fragments).

passenger car suggested that the motorcycle first colliding with the car was in an upright position at the moment of impact. In the collision, the front wheel and the stanchion tubes were ripped off the motorcycle. Then the car collided with the second motorcycle, which had started braking before, so that it tilted to the right and hit the car sliding on the ground. During that phase, one of the stanchion tubes from the ripped off front wheel of the other motorcycle must have entered the body. Subsequently, the impaling object left the victim again and ultimately reached its final position beside his motorcycle, while the motorcyclist himself was flung into the direction of travel for another 70 m.

3. Discussion

Traffic accidents are the leading cause of fatal impalement injuries. Most of the victims are drivers or car passengers. Among the diverse implements which may enter the occupant's body, only a few shall be mentioned here: gear sticks and brake handles [16,17,20,24], wooden fence posts or metallic tubes from the roadside [9–14,19,21–23,47], pointed objects from the car's luggage compartment [5], a telescopic shock absorber of the tailgate support [6], a branch broken off from a tree along the road [48] or an iron rod protruding from the loading space of a truck [18]. Wooden fence posts, which enter the car through the windshield, may be covered with tiny glass fragments pressed into the blunt-tipped front end. Impalements of cyclists and motorcyclists seem to be rarities [6]. Levis and Craig reported on a 75-year-old man, who fell from his bicycle impaling his upper lip with the brake handle [15].

In our case, two motorcyclists were fatally injured in consecutive head-on collisions with an oncoming car. On impact, the first motorcycle disintegrated so that the front wheel together with its broken fork separated from the rest of the accident vehicle. The following motorcyclist was impaled by one of the stanchion tubes attached to the front wheel. At first, the steel tube came into tangential contact with the helmeted head and then perforated the protective clothing and the underlying thoracic wall of the right upper back producing a 30 cm long, steeply descending wound

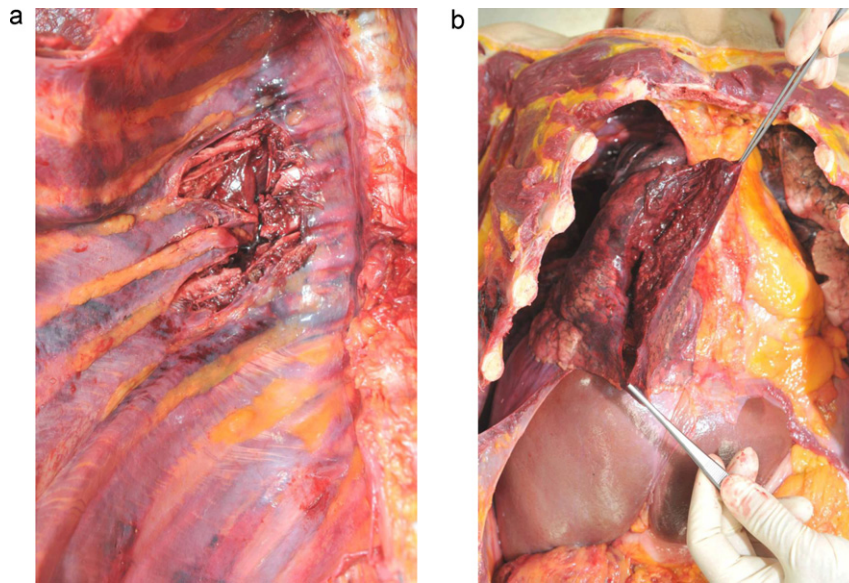


Fig. 5. Interior aspect of the right posterior thoracic wall (a) and channel shaped lesion of the right lung (b).

channel extending to the abdominal cavity. Immediately after this deep penetration, the impaling object was withdrawn again due to different movement directions of the front wheel and the victim's body. As a result, the final position of the front wheel with its broken fork was far apart from the fatally injured motorcyclist.

At the scene of the accident, the extensively damaged helmet suggested a severe craniocerebral trauma. Therefore, it seems understandable that the emergency doctor and the police officers attributed the fatal outcome to a blunt head injury in spite of the large and obviously penetrating wound located in the upper dorsal region. This erroneous assumption is understandable as the first medical examination at the scene was limited to the assessment of death and did not include complete undressing of the body and inspection of the uncovered back. Besides, no impaling object protruded from the entrance wound. As a whole, these circumstances explain why the real kind of traumatization was only detected at autopsy.

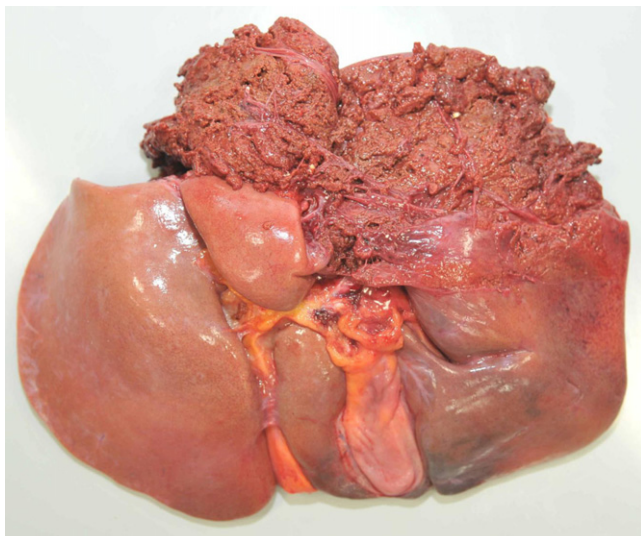


Fig. 6. Undersurface of the liver with extensive destruction of its right lobe.

Another aspect to be emphasized in the reported case is that two separate body parts were injured consecutively by the same object. At first, the stanchion tube hit the back of the helmeted head tangentially cutting off only a small piece of the scalp. Then the metal tube penetrated the protective clothing of the upper back, the underlying skin and the posterior thoracic wall. Due to the steeply descending course and the length of the wound track, both the right thoracic cavity and the abdomen were affected. The presence of injuries in different body parts caused by one and the same object allows drawing a parallel with the well-known re-entry type of stab and gunshot wounds [49]. In clinical medicine, thoracoabdominal impalement requires a multidisciplinary team consisting of trauma, thoracic, plastic, and hepatobiliary surgeons [23].

From the view of biomechanics, it is remarkable that in our case both the impaling object and the motorcyclist were moving at the time of impact. Usually, impalement is caused by a fixed obstacle such as a fence post. Alternatively, the injuring object (e.g. a steel bar) may drop from a height before striking a person below [30].

The stanchion tube acting as the wounding object was a cylindrical steel pipe with a sharp-edged end (cf. Fig. 1b). Thus, the injuring mechanism is not the same as in impalements from blunt-tipped rods or posts. Apart from local displacement, tissues may be punched out and carried (displaced) either along the wound channel or into the cavity of the tube. A comparable effect has been described for bamboo sticks containing hollow spaces inside [1] and for steel bolts of slaughterer's guns [50].

In the concrete case, the impaling object was only detected during an additional search for an object that could have impaled the motorcyclist's body. When closely looking at the vehicles involved in the accident, it turned out that a stanchion tube of the separated front wheel might have caused the injury. Dried blood traces on the surface (cf. Fig. 1b) were analyzed and revealed a DNA profile consistent with that of the victim. The interior of the tube contained punched out parts of the motorcyclist's helmet.

Within the body, foreign material deriving from the helmet and the protection jacket was found along the whole wound track (cf. Fig. 4). A cut-off piece of the hairy scalp had got lodged close to the undersurface of the liver. Its location proved that both the head and the trunk injury had been inflicted by the same mechanism.

Another remarkable fact is the absence of any other relevant traumatization apart from the thoracoabdominal impalement. Therefore, death was attributed to the extensive tissue destruction of the right lung and the liver with consecutive exsanguination at the scene of the accident.

4. Conclusions

- In motorcycle crashes with disintegration of the vehicle, a stanchion tube may act as an impaling object.
- Even a large penetrating wound can be overlooked by the emergency doctor if it is located on the back of the body and/or is covered by clothing during the external examination.
- A tube-like impaling object with a sharp-edged end may contain punched-out material from the clothing and biological traces.
- Under special circumstances, more than one body part can be injured by the same impaling object (analogous to re-entry wounds in gunshots and stabs).

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